GENERAL PRACTICE IN CHINA

# Detection Rate of Non-alcoholic Fatty Liver Disease and Its Influencing Factors：Analysis Based on the Data of 320 000 Beijing Population

DOU Ziyan, QIAN Wenhong, KONG Lingrun, CHEN Ye, LI Mingliang, ZHANG Jingbo*

Beijing Physical Examination Center, Beijing 100050, China

*Corresponding author：ZHANG Jingbo, Research fellow；E-mail：13910625118@139.com



**Recommended Citation**

DOU Z Y, QIAN W H, KONG L R, et al. Detection rate of non-alcoholic fatty liver disease and its influencing factors：analysis based on the data of 320 000 Beijing population［J］. Chinese General Practice, 2024, 27（2）：144-149, 155.

DOI：10.12114/j.issn.1007-9572.2023.0465.

Available at： https：//gpinchina.net

# Detection Rate of Non-alcoholic Fatty Liver Disease and Its Influencing Factors：Analysis Based on the Data of 320 000 Beijing Population

*DOU Ziyan, QIAN Wenhong, KONG Lingrun, CHEN Ye, LI Mingliang, ZHANG Jingbo**

**【Abstract】** **Background** Non-alcoholic fatty liver disease has showed a high prevalence and a increasing trend especially towards younger age. It is of great public health significance to reduce damage through early detection of NAFLD in physical examination and intervention in time. **Objective** To investigate the detection rate of NAFLD in the Beijing physical examination population from 2018 to 2021, and analyze its related influencing factors. **Methods** People who received physical examinations at the Beijing Physical Examination Center from 2018-01-01 to 2021-12-31 were selected based on the inclusion criteria, the results of physical examination, laboratory examination, and liver ultrasonography were collected for analysis. Univariate analysis was performed using t-test, Mann-Whitney U test and chi-square test. Multivariate Logistic regression was used to explore the influencing factors of NAFLD. **Results** A total 325 726 people were included in the study, of which 108 512 cases of NAFLD were detected, with a detection rate of 33.31%. The results of liver ultrasonography revealed that the number of mild, moderate and severe NAFLD detections were 74 062, 33 281 and 1 169 cases, accounting for 68.25%, 30.67% and 1.08% of the detection population, respectively. The detection rate of NAFLD was higher in males than females（$\chi^2$=17 518.893, $P$<0.05）. Chi-square test for trend revealed an age-dependent increase detection rate of NAFLD before 70 years old, and a subsequent decline after reaching 70 years old（$\chi^2$=14 397.61, $P$<0.001）. Higher detection rate was revealed in males than females among people aged 18-59 years（$P$<0.05）, while lower detection rate in males than females among people aged ≥ 70 years old（$P$<0.05）. Multivariate Logistic regression results showed that gender（male：*OR*=1.173）, aging（30-39：*OR*=1.604, 40-49：*OR*=1.948, 50-59：*OR*=2.486, 60-69：*OR*=2.663, 70-79：*OR*=2.079, ≥80：*OR*=1.149）, BMI（18.5-23.9 kg/m$^2$：*OR*=2.997, 24.0-27.9 kg/m$^2$：*OR*=3.911, ≥28.0 kg/m$^2$：*OR*=11.780）, systolic blood pressure（SBP）（≥140 mmHg：*OR*=1.200）, diastolic blood pressure（DBP）（≥90 mmHg：*OR*=1.177）, fasting blood glucose（FBG）(≥6.10 mmol/L：*OR*=1.934）, triacylglycerol（TG）（≥ 1.70 mmol/L：*OR*=2.946）, total cholesterol（TC）（≥ 5.20 mmol/L：*OR*=1.050）, high-density lipoprotein cholesterol （HDL-C）（<1.0 mmol/L：*OR*=1.645）, low-density lipoprotein cholesterol

（LDL-C）（≥ 3.4 mmol/L：*OR*=1.499）, uric acid（UA）（UAmale>420 μmol/L, UAfamale>360 μmol/L：*OR*=2.067） were influencing factors for NAFLD （*P*<0.001）. **Conclusion** The detection rate of NAFLD in physical examination population in Beijing was 33.31%, the highest incidence showed in people aged 50 to 69 years. Males, overweight and obese people are the high-risk groups, and abnormalities in blood lipids, blood pressure and blood glucose are also risk factors for NAFLD.

**【Key words】** Non-alcoholic fatty liver disease；Physical examination population；Prevalence；Root Cause Analysis；Beijing

With the continuous improvement of social and economic levels, people's lifestyles have changed, and chronic diseases have gradually replaced infectious diseases as the primary threats to human health[1-2]. Clinically, fatty liver is divided into alcoholic liver disease（ALD） and non-alcoholic fatty liver disease （NAFLD）. NAFLD is the most common liver disease with a global prevalence of about 25%[3]. Studies show that its prevalence is increasing yearly, with a trend towards affecting younger individuals[4]. The prevalence of NAFLD in Asia is approximately 27.4%[5]. In China, the incidence of NAFLD is reported to be between 15% and 30%[6]. A Meta-analysis showed that the prevalence of NAFLD in China was 32.9% in 2018[7]. NAFLD has become the most significant chronic liver disease in the country and the leading cause of abnormal liver biochemical indicators in health check-ups[8].

Research indicates that the overall mortality rate, liver-specific morbidity, and mortality risk are significantly increased in NAFLD patients[9]. NAFLD can also lead to a series of adverse outcomes in liver organs and systems and is closely associated with high incidences of metabolic syndrome, type 2 diabetes, atherosclerotic cardiovascular diseases, and colorectal tumors[10]. The threat of NAFLD has surpassed hepatitis B and C, becoming the primary cause of liver-related deaths worldwide[11]. Because NAFLD is generally asymptomatic in its early stages and not easily detected, early diagnosis and intervention are crucial to prevent adverse outcomes. Furthermore, NAFLD is reversible[12], changes in lifestyle and diet can effectively reverse the condition. Guidelines established by the American Clinical Endocrinology Association and the American Liver Disease Association indicate that NAFLD patients who reduce their weight by more than 5% can decrease liver fat content and improve cardiac metabolism. A weight loss of more than 10% can potentially reverse fatty hepatitis or liver fibrosis[13]. Achieving weight reduction by improving lifestyle is an effective way to reduce the disease burden of NAFLD and is recommended as the primary preventive measure for this disease[14]. Therefore, early detection, diagnosis, intervention, and treatment of NAFLD are effective ways to reduce its disease burden, and physical examination is an effective means to detect NAFLD as

early as possible. This study, based on the population that underwent health examinations at a Beijing examination center from 2018 to 2021, aims to analyze the detection of NAFLD and other related characteristics to provide a theoretical basis for the prevention of NAFLD in Beijing.

## 1 Subjects and methods

**1.1 Study subjects** A total of 360 343 individuals who underwent health examinations at a Beijing City Examination Center from January 1, 2018, to December 31, 2021 were selected as the study subjects. Inclusion criteria was age ≥18 years. Exclusion criteria included chronic hepatitis C, history of malignant liver tumors, other liver and biliary diseases, missing vital information（height, weight, fatty liver detection indicators, age, gender）, and self-reported heavy drinking. After applying the inclusion and exclusion criteria, a total of 325 726 individuals were included in this study. The flowchart of participant inclusion was shown in figure 1.

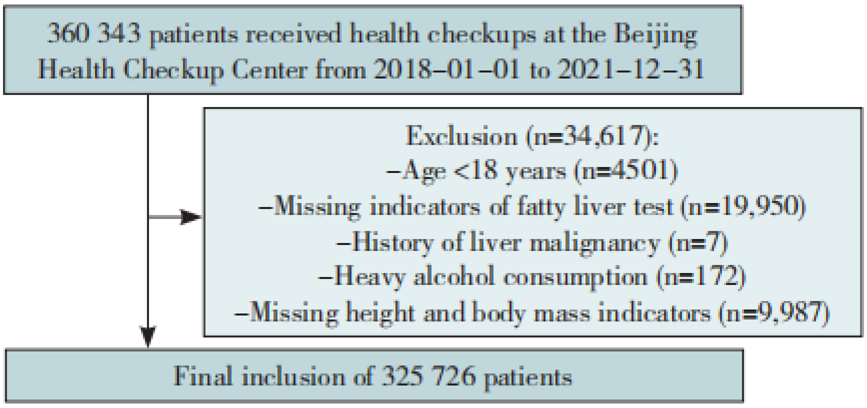


**Figure 1** Research subjects screening flow chart

**1.2 Methods** Examination content and methods：（1）Physical examination, including height, weight, and blood pressure. All examinees were measured in light clothing, without shoes and hats, after emptying the bladder. Height was measured to the nearest 0.001 m and weight to the nearest 0.1 kg. BMI was calculated based on height and weight. Blood pressure was measured after a 5-min rest in a quiet environment, seated position, using an OMRON HBP-9020 automatic electronic blood pressure monitor. Laboratory tests： blood was drawn after a 12-hour fast and analyzed using a Beckman AU5400 automatic biochemical analyzer to measure blood biochemical indicators including triglycerides （TG）, fasting blood glucose （FBG）, total cholesterol （TC）, high-density lipoprotein cholesterol（HDL-C）, low-density lipoprotein cholesterol（LDL-C）, and uric acid（UA）.（3）Liver ultrasound：performed by a radiologist using a GE LOGIQ E9 color Doppler ultrasound machine （abdominal probe frequency 1-6MHz）.

**1.3 Key detection items and evaluation criteria**

**1.3.1 Fatty liver** The diagnosis was based on the following ultrasonic characteristics[15]: diffuse enhancement of near-field echoes in the liver area （stronger than the kidney and spleen） with gradual attenuation of far-field echoes; poor visualization of intrahepatic ductal structures; mild to moderate liver enlargement with rounded edges; reduced or hard to visualize intrahepatic color flow signals in color Doppler flow imaging, but with normal vascular orientation; poor or incomplete visualization of the right hepatic capsule and diaphragmatic echoes. A diagnosis of mild fatty liver was made with the first criterion plus one of criteria 2-4; moderate fatty liver with the first criterion and two of criteria 2-4; severe fatty liver with the first criterion, two of criteria 2-4, and criteria 5.

**1.3.2 Other indicators** FBG>6.1 mmol/L indicates abnormal blood glucose[16]. Blood pressure ≥140/90 mmHg is considered abnormal according to the 2018 version of the Chinese Hypertension Prevention Guide[17]. Abnormal lipid indicators include TG ≥ 1.7 mmol/L, TC ≥ 5.2 mmol/L, HDL-C<1.0 mmol/L, and LDL-C ≥ 3.4 mmol/L[18]. Hyperuricemia is defined as UA>420 μmol/L in men and UA>360 μmol/L in women[19]. BMI is evaluated according to the "Adult Body Mass Determination" （WS/T428-2013）[20], where BMI<18.5 kg/m$^2$ is considered underweight, 18.5≤BMI<24.0 kg/m$^2$ is considered normal, 24.0≤BMI<28.0 kg/m$^2$ is considered overweight, and BMI ≥28.0 kg/m$^2$ is considered obesity.

**1.4 Statistical methods** Examination data were exported and organized using Excel; outlier values were excluded based on professional judgment. SPSS 23.0 software was used for data analysis. Normally distributed quantitative data were represented as（$\bar{x}\pm s$）, and non-normally distributed data were expressed as $M$（$P_{25}$, $P_{75}$）. Independent sample t-tests and rank-sum tests were used for intergroup comparisons of quantitative data; chi-square test tests were used for categorical data. Influencing factors were analyzed using unconditional Logistic regression（LR backward), with $\alpha_{in}$ =0.05 and $\alpha_{out}$ =0.10. $P$<0.05 was considered statistically significant.

**2 Results**

**2.1 Detection of NAFLD** Out of 325 726 individuals examined, 170 256 （52.30%） were male, and 155,470 （47.70%） were female, with ages ranging from 18 to 98 and an average age of （42.4±14.6） years. NAFLD was detected in 108 512 cases, with a prevalence of 33.31%. According to the liver ultrasound diagnosis, 74 062 individuals （68.25% of detected cases） had mild NAFLD, 33,281 （30.67%） had moderate NAFLD, and 1,169 （1.08%） had severe NAFLD.

**2.2 Comparison of general data and laboratory test indicators between NAFLD and Non-NAFLD populations** The age, FBG, SBP, DBP, TG, TC, LDL-C, and UA of the NAFLD group were higher than those of

the non-NAFLD group. Also, the body weight and BMI were higher in the NAFLD group, while HDL-C was lower compared to the non-NAFLD group. All differences were statistically significant （$P$<0.05）, as shown in table 1.

**Table 1** Comparison of general data and laboratory test indicators between NAFLD and non-NAFLD populations

| Item | NAFLD population（108 512） | Non-NAFLD population（217 214） | $t$（$Z$） value | $P$ value |
|---|---|---|---|---|
| Age（years） | 46.9±13.8 | 40.2±14.4 | 127.616 | <0.001 |
| Body mass（kg） | 74.7±11.9 | 63.4±11.3 | 259.703 | <0.001 |
| BMI（kg/m） | 27.4±3.5 | 23.0±3.2 | 350.240 | <0.001 |
| FBG（mmol/L） | 5.33（4.99, 5.88） | 4.96（4.7, 5.28） | 184.447 | <0.001 |
| SBP（mmHg） | 130（120, 141） | 119（109, 130） | 168.130 | <0.001 |
| DBP（mmHg） | 79（72, 87） | 71（65, 79） | 169.302 | <0.001 |
| TG（mmol/L） | 1.63（1.17, 2.31） | 0.91（0.66, 1.29） | 263.997 | <0.001 |
| TC（mmol/L） | 5.03（4.41, 5.69） | 4.68（4.12, 5.32） | 89.719 | <0.001 |
| HDL-C（mmol/L） | 1.12（0.98, 1.29） | 1.36（1.16, 1.59） | -204.841 | <0.001 |
| LDL-C（mmol/L） | 3.09（2.55, 3.64） | 2.76（2.29, 3.29） | 97.543 | <0.001 |
| UA（μmol/L） | 380（319, 445） | 307（254.1, 370.6） | 192.366 | <0.001 |

Notes： [a] indicates that the indicator has missing values, none of which exceeds 10%; [b] indicates a $t$ value; NAFLD= non-alcoholic fatty liver disease, SBP= systolic blood pressure, DBP= diastolic blood pressure, TG= triacylglycerol, FBG= fasting blood glucose, TC= total cholesterol, HDL-C=high-density lipoprotein cholesterol, LDL-C= low-density lipoprotein cholesterol, UA= blood uric acid; 1 mmHg=0.133 kPa.

**2.3 Comparison of NAFLD detection rates among different age groups, genders, and BMI categories** There were significant differences in NAFLD detection rates among different age groups, genders, and BMI categories （$P$<0.05）. The detection rate of NAFLD was higher in males than females （$P$<0.05）, as shown in table 2. Trend chi-square tests showed a trending change in NAFLD detection rates among different age groups （$\chi^2$=14 397.61, $P$<0.001）. The detection rate of NAFLD increased with age until 70, after which it declined.

**Table 2** Comparison of NAFLD detection rate by age, sex and BMI

| Item | Cases | NAFLD detecting rate | $\chi^2$ value | *P* value |
|---|---|---|---|---|
| Age（year） | | | 18 343.962 | <0.001 |
| 18-30 | 66 673 | 10 323（15.48） | | |
| 30-39 | 97 312 | 28 960（29.76） | | |
| 40-49 | 63 315 | 23 850（37.67） | | |
| 50-59 | 52 363 | 24 510（46.81） | | |
| 60-69 | 30 296 | 14 436（47.64） | | |
| 70-79 | 11 533 | 5 091（44.14） | | |
| ≥80 | 4 234 | 1 342（31.70） | | |
| Gender | | | 17 518.893 | <0.001 |
| Male | 170 256 | 74 503（43.76） | | |
| Female | 155 470 | 34 009（21.87） | | |
| BMI | | | 73 546.527 | <0.001 |
| BMI<18.5 | 19 433 | 5 402（27.80） | | |
| 18.5≤BMI<24.0 | 146 784 | 17 247（11.75） | | |
| 24.0≤BMI<28.0 | 113 386 | 51 556（45.47） | | |
| BMI≥28.0.0 | 46 123 | 34 307（74.38） | | |

In the age group of 18-59 years, the detection rate of NAFLD was significantly higher in males than females （$P$<0.05）. Between the ages of 60-69, there was no significant difference in NAFLD detection rates between genders （$P$>0.05）. In individuals aged ≥70 years, the detection rate of NAFLD was significantly lower in males than females （$P$<0.05）, as shown in table 3.

**Table 3** Comparison of the detection rate of NAFLD in males and females by age

| Age (year) | Male | | Female | | $\chi^2$ value | $P$ value |
|---|---|---|---|---|---|---|
| | Cases | NAFLD detecting tate | Cases | NAFLD detecting tate | | |
| 18~30 | 31 619 | 8 414（26.61） | 35 054 | 1 909（5.45） | 5 690.626 | <0.001 |
| 30~39 | 49 550 | 22 543（45.50） | 47 762 | 6 417（13.44） | 11 958.379 | <0.001 |
| 40~49 | 33 900 | 17 000（50.15） | 29 415 | 6 850（23.29） | 4 839.366 | <0.001 |
| 50~59 | 30 687 | 15 850（51.65） | 21 676 | 8 660（39.95） | 698.239 | <0.001 |
| 60~69 | 15 417 | 7 277（47.20） | 14 879 | 7 159（48.11） | 2.534 | 0.111 |
| 70~79 | 6 366 | 2 603（40.89） | 5 167 | 2 488（48.15） | 61.012 | <0.001 |
| ≥80 | 2 717 | 816（30.03） | 1 517 | 526（34.67） | 9.683 | 0.002 |

**2.4 Multifactorial Logistic regression analysis of factors affecting NAFLD** The occurrence of NAFLD was set as the dependent variable（assigned values： yes=1, no=0）, and statistically significant indicators from table 1 were set as independent variables（assigned values shown in table 4）. Multifactorial unconditional Logistic regression analysis results indicated that gender, age, BMI, SBP, DBP, FBG, TG, TC, LDL-C, and UA were influencing factors for the occurrence of NAFLD（$P$<0.05）, as shown in table 5.

**Table 4** Multivariate Logistic regression analysis of factors influencing the development of NAFLD in the physical examination population

| Independent variables | Assignment |
|---|---|
| Age | 18~30＝0, 30-49＝1, 40-49=2, 50-59=3, 60-69=4, 70-79=5, ≥80=6 |
| Gender | Male=1, female=2 |
| BMI | 18.5~23.9 kg/m=0；<18.5 kg/m=1；24.0~27.9 kg/m=2；≥28.0 kg/m=3 |
| SBP | <140 mmHg=0；≥140 mmHg=1 |
| DBP | <90 mmHg=0；≥90 mmHg=1 |

| | |
|---|---|
| TG | <1.70 mmol/L=0；≥1.70 mmol/L=1 |
| TC | <5.20 mmol/L=0；≥5.20 mmol/L=1 |
| FBG | <6.10 mmol/L=0；≥6.10 mmol/L=1 |
| HDL-C | ≥1.0 mmol/L=0；<1.0 mmol/L=1 |
| LDL-C | <3.4 mmol/L=0；≥3.4 mmol/L=1 |
| UA | Male≤420 μmol/L=0, >420 μmol/L=1；Female≤360 μmol/L=0, >360 μmol/L=1 |

**Table 5** Multivariate Logistic regression analysis of influencing factors of NAFLD in physical examination population

| Item | $\beta$ | *SE* | Wald $\chi^2$ value | *P* value | *OR*（95*CI*） |
|---|---|---|---|---|---|
| Gender | | | | | |
| Male | 0.160 | 0.011 | 224.655 | <0.001 | 1.173（1.149~1.198） |
| Age | | | | | |
| 30-39 | 0.473 | 0.017 | 793.421 | <0.001 | 1.604（1.552~1.658） |
| 40-49 | 0.667 | 0.018 | 1 384.985 | <0.001 | 1.948（1.881~2.018） |
| 50-59 | 0.911 | 0.019 | 2 408.133 | <0.001 | 2.486（2.397~2.578） |
| 60-69 | 0.979 | 0.021 | 2 214.529 | <0.001 | 2.663（2.556~2.774） |
| 70-79 | 0.732 | 0.028 | 692.658 | <0.001 | 2.079（1.968~2.195） |
| ≥80 | 0.139 | 0.043 | 10.556 | <0.001 | 1.149（1.057~1.249） |
| BMI | | | | | |
| 18.5~23.9 kg/m | 1.098 | 0.022 | 2 510.233 | <0.001 | 2.997（2.871~3.129） |
| 24.0~27.9 kg/m | 1.364 | 0.011 | 14 062.805 | <0.001 | 3.911（3.823~4.000） |
| ≥28.0 kg/m | 2.466 | 0.015 | 25 342.403 | <0.001 | 11.780（11.427~12.143） |
| SBP | | | | | |
| ≥140 mmHg | 0.183 | 0.015 | 152.265 | <0.001 | 1.200（1.166~1.236） |
| DBP | | | | | |
| ≥90 mmHg | 0.163 | 0.017 | 89.119 | <0.001 | 1.177（1.138~1.218） |
| TG | | | | | |
| ≥1.70 mmol/L | 1.081 | 0.012 | 8 656.887 | <0.001 | 2.946（2.880~3.014） |

| | | | | | |
|---|---|---|---|---|---|
| TC | | | | | |
| ≥5.20 mmol/L | 0.049 | 0.015 | 10.732 | <0.001 | 1.050（1.020~1.082） |
| FBG | | | | | |
| ≥6.10 mmol/L | 0.659 | 0.015 | 1 817.424 | <0.001 | 1.934（1.876~1.993） |
| HDL-C | | | | | |
| <1.0 mmol/L | 0.498 | 0.014 | 1 577.669 | <0.001 | 1.645（1.605~1.686） |
| LDL-C | | | | | |
| ≥3.4 mmol/L | 0.405 | 0.015 | 692.283 | <0.001 | 1.499（1.455~1.545） |
| UA | | | | | |
| male>420 μmol/L, female>360 μmol/L | 0.726 | 0.011 | 4 111.984 | <0.001 | 2.067（2.021~2.113） |

## 3 Discussion

The liver is the main site of lipid metabolism in the human body, with functions including the storage of glycogen, metabolic regulation, detoxification, and biotransformation. Patients with NAFLD are prone to progression to cirrhosis, fibrosis, or even liver function failure[21]. Although the progression rate to liver cancer is relatively low, there is a gradual increasing trend[22]. Connections between NAFLD and extrahepatic tumors have also been discovered in different studies[23]. However, most patients exhibit no obvious symptoms in the early stages[24], making prevention of NAFLD particularly crucial.

The pathogenesis of fatty liver is still unclear, but studies indicate its association with hyperlipidemia, hyperglycemia, obesity, and other factors[6]. Our study analyzed the detection of NAFLD and its related risk factors among a population undergoing physical examinations in Beijing, aiming to provide fundamental data for the understanding, monitoring, prevention, and health management of NAFLD in this population.

The results reveal that the detection rate of NAFLD is approximately 33% among individuals aged 18 and above, higher than in some regions in China[25-26] and similar to other studies[27]. The variations in detection rates might be attributed to differences in lifestyle and environmental factors between regions. Male NAFLD detection rates exceeded those of females, with the highest detection rate of over 45% occurring in the 50-69 age group, which is lower than the elderly population over 60 in Shanghai[28], but higher than the elderly population in certain areas of Hebei province[29]. However, the results for NAFLD in older populations are generally consistent, with most studies finding a decrease in the prevalence of fatty liver over the age of 70 years[30].

Multifactorial Logistic regression analysis revealed that BMI is a risk factor for NAFLD. Obesity （BMI≥ 8.0 kg/m²） had the highest OR value of 11.780, surpassing that found in Ye Yao's study[24] on the elderly. Weight reduction is an essential measure for the prevention and treatment of NAFLD and its complications[31]. Diet restriction has been proven effective in reducing hepatic TG content by 6.9% compared to the baseline over a 12-month clinical trial[32]. A weight reduction of over 10% maintained for one year is required to reverse liver fibrosis[33].

Interestingly, our study identified leanness as a risk factor for NAFLD. Despite a lower incidence of metabolic syndrome compared to overweight and obese populations, lean individuals with NAFLD have higher overall mortality rates[34]. Their risks for all-cause death, liver-related death, and tumors related to the digestive system and obesity are higher compared to both overweight/obese NAFLD and lean non-NAFLD populations[35]. The risk of all-cause mortality, liver-related mortality, gastrointestinal tumors, and obesity-related tumors was higher in overweight or obese NAFLD and lean non-NAFLD populations than in overweight or obese NAFLD [36]. Therefore, the risk of NAFLD in the lean population needs special attention and should be monitored regularly. In addition, it is recommended to use body composition analyzers to measure body fat content, body mass index, and and skeletal muscle mass to detect hidden obesity to detect hidden obesity and sarcopenia[37].

Anomalies in TG, TC, LDL-C, and HLD-C are consistent risk factors for NAFLD, aligning with other studies[38-39]. The higher sensitivity diagnostic criteria for dyslipidemia used in our study, based on marginal elevation standards from the revised 2016 Chinese guidelines, might result in smaller OR values compared to studies using elevated standards. Elevated blood pressure is another risk factor for NAFLD, as confirmed by Yang Guiling's research[40], potentially due to its association with cardiovascular complications, particularly arteriosclerosis.

In summary, the NAFLD detection rate is high among the examined population in Beijing, particularly among males and those aged 50-69. Both lean and overweight individuals are at risk, along with those showing anomalies in blood pressure, blood glucose, and blood lipids. Regular ultrasound or liver biopsies, lifestyle adjustments, and close monitoring of related indicators are essential for high-risk individuals.

The limitations of our study include the use of ultrasound for NAFLD diagnosis instead of liver biopsy, the gold standard, and potential information and selection biases due to self-reported data and exclusion criteria. Future cohort and experimental studies are needed to further explore factors influencing NAFLD occurrence and development and to identify feasible intervention measures.

**Author Contributions:** Dou Ziyan and Zhang Jingbo conceived the research idea, designed the study, and wrote the paper. Qian WenHong was responsible for data analysis and interpretation of the results. Kong Linrun and

Li Mingliang handled data collection and organization. Chen Ye took charge of revising the manuscript.

There is no conflict of interest in this article.

**References**

［1］WHO. Preventing chronic diseases：a vital investment［R］. 2005.

［2］WANG L Y. Challenges and responses to chronic disease management in the community［J］. Shanghai Journal of Preventive Medicine, 2003, 15（9）：475-476. DOI：10.19428/j.cnki.sjpm.2003.09.030.

［3］COTTER T G, RINELLA M. Nonalcoholic fatty liver disease 2020：the state of the disease［J］. Gastroenterology, 2020, 158（7）：1851-1864. DOI：10.1053/j.gastro.2020.01.052.

［4］ALLEN A M, THERNEAU T M, LARSON J J, et al. Nonalcoholic fatty liver disease incidence and impact on metabolic burden and death：a 20 year-community study［J］. Hepatology, 2018, 67（5）：1726-1736. DOI：10.1002/hep.29546.

［5］YOUNOSSI Z M, KOENIG A B, ABDELATIF D, et al. Global epidemiology of nonalcoholic fatty liver disease-Meta-analytic assessment of prevalence, incidence, and outcomes［J］. Hepatology, 2016, 64（1）：73-84. DOI：10.1002/hep.28431.

［6］HAN J. A survey on the prevalence of non-alcoholic fatty liver disease, analysis of risk factors and clinical study on the relationship with atherosclerosis［D］. Jinan：Shandong University, 2019.

［7］ZHOU J H, ZHOU F, WANG W X, et al. Epidemiological features of NAFLD from 1999 to 2018 in China［J］. Hepatology, 2020, 71（5）：1851-1864. DOI：10.1002/hep.31150.

［8］WANG F S, FAN J G, ZHANG Z, et al. The global burden of liver disease：the major impact of China［J］. Hepatology, 2014, 60（6）：2099-2108. DOI：10.1002/hep.27406.

［9］IANNONE V, LOK J, BABU A F, et al. Associations of altered hepatic gene expression in American lifestyle-induced obesity syndrome diet-fed mice with metabolic changes during NAFLD development and progression［J］. J Nutr Biochem, 2023, 115：109307. DOI：10.1016/j.jnutbio.2023.109307.

［10］WANG Z Y, ZHAO X Y, CHEN S H, et al. Associations between nonalcoholic fatty liver disease and cancers in a large cohort in China［J］. Clin Gastroenterol Hepatol, 2021, 19（4）：788-796.e4. DOI：10.1016/j.cgh.2020.05.009.

［11］RINELLA M, CHARLTON M. The globalization of nonalcoholic fatty liver disease：prevalence and impact on world health［J］. Hepatology, 2016, 64（1）：19-22. DOI：10.1002/hep.28524.

［12］WANG L, ZHANG Z H, FENFG J, et al. Analysis of the prevalence and risk factors of fatty liver in a physical examination population of a unit in Luzhou city［J］. Modern Preventive Medicine, 2018, 45（6）：1109-1113.

［13］CUSI K, ISAACS S, BARB D, et al. American association of clinical endocrinology clinical practice guideline for the diagnosis and management of nonalcoholic fatty liver disease in primary care and endocrinology clinical settings：co-sponsored by the American association for the study of liver diseases［J］. Endocr Pract, 2022, 28（5）：528-562. DOI：10.1016/j.eprac.2022.03.010.

［14］Fatty Liver Disease and Alcoholic Liver Disease Group of the Hepatology Section of the Chinese Medical Association, Expert Committee on Fatty Liver Disease, Chinese Medical Doctors' Association. Guidelines for the prevention and treatment of non-alcoholic fatty liver disease （2018 update）［J］. Journal of Clinical Hepatology, 2018, 34（5）：947-957.

［15］FAN J G. Chinese guidelines for the diagnosis and treatment of non-alcoholic fatty liver disease （2010 revision）［J］. Chinese Journal of the Frontiers of Medical Science（Electronic Version）, 2012, 4（7）：4-10.

［16］Chinese Medical Association Diabetes Branch. Guidelines for the prevention and control of type 2 diabetes in China （2017 edition）［J］. Chinese Journal of Practical Internal Medicine, 2018, 38（4）：292-344. DOI：10.19538/j.nk2018040108.

［17］China Hypertension Prevention and Treatment Guidelines Revision Committee, Hypertension Alliance（China）, Chinese Society of Cardiovascular Disease, et al. Chinese guidelines for the prevention and treatment of hypertension （2018 Revision）［J］. Chinese Journal of Cardiovascular Medicine, 2019, 24（1）：24-56.

［18］ZHU J R, GAO R L, ZHAO S P, et al. Chinese guidelines for prevention and control of dyslipidemia in adults（2016 revision）［J］. Chinese Circulation Journal, 2016, 31（10）：937-953.

［19］Chinese Society of Endocrinology. Chinese guidelines for the diagnosis and treatment of hyperuricemia and gout （2019）［J］. Chinese Journal of Endocrinology and Metabolism, 2020, 36（1）：1-13.

［20］General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China, Standardization Administration of PRC （SAC）. WS/T428-2013 Adult weight determination［M］. Beijing：China Standard Publishing House, 2013.

［21］ZHOU Y, GUAN M Q. Correlation analysis of fatty liver with hypertension, hyperlipidemia, diabetes mellitus, and body mass index［J］. Modern Interventional Diagnosis and Treatment in Gastroenterology, 2017, 22（3）：382-384. DOI：10.3969/j.issn.1672-2159.2017.03.031.

［22］KIM D, LI A A, PERUMPAIL B J, et al. Changing trends in etiology-based and ethnicity-based annual mortality rates of cirrhosis and hepatocellular carcinoma in the United States［J］. Hepatology, 2019, 69（3）：1064-1074. DOI：10.1002/hep.30161.

［23］MANTOVANI A, DAURIZ M, BYRNE C D, et al. Association between nonalcoholic fatty liver disease and colorectal tumours in asymptomatic adults undergoing screening colonoscopy：a systematic review and meta-analysis［J］. Metabolism, 2018, 87：1-12. DOI：10.1016/j.metabol.2018.06.004.

［24］LI X F, CHEN J J, PIAO Z F. Analysis of liver function, lipid and blood glucose levels in patients with non-alcoholic fatty liver disease［J］. Chinese Hepatology, 2016, 21（7）：567-569. DOI：10.14000/j.cnki.issn.1008-1704.2016.07.013.

［25］WANG Q, WU S, BAI Y R, et al. A study of the relationship between dietary patterns and non-alcoholic fatty liver disease based on structural equation modeling［J］. Chinese Journal of Prevention and Control of Chronic Diseases, 2022, 30（11）：873-876. DOI：10.16386/j.cjpccd.issn.1004-6194.2022.11.016.

［26］YANG Y, LI F, KONG L X, et al. Detection of non-alcoholic fatty liver disease in male medical check-up population in Yudongbei, Chongqing and related analysis［J］. Journal of Chongqing Medical University, 2022, 47（9）：1047-1052. DOI：10.13406/j.cnki.cyxb.003098.

［27］WANg Z B, SONG G H, WANG Y L, et al. Relationship between sarcopenic obesity and nonalcoholic fatty liver disease［J］. Chinese Journal of Prevention and Control of Chronic Diseases, 2019, 27（11）：814-817. DOI：10.16386/j.cjpccd.issn.1004-6194.2019.11.004.

［28］CHANG Q X, WANG X M, WANG C, et al. An association rule-based study of risk factors associated with fatty liver in elderly people［J］. Chinese Journal of Health Statistics, 2022, 39（4）：558-561. DOI：10.3969/j.issn.1002-3674.2022.04.017.

［29］GAO Q S, MA A J, CHENG L L, et al. Analysis of the prevalence and associated factors of non-alcoholic fatty liver disease in an elderly physical examination population［J］. Practical Preventive Medicine, 2022, 29（9）：1102-1105.

［30］YE Y, CHEN W Q, LONG L Y, et al. Association analysis of body mass and triglyceride interaction on non-alcoholic fatty liver disease in the elderly［J］. Modern Preventive Medicine, 2022, 49（6）：992-996, 1002.

［31］ROMERO-GOMEZ M, ZELBER-SAGI S, TRENELL M. Treatment of NAFLD with diet, physical activity and exercise［J］. J Hepatol, 2017, 67（4）：829-846. DOI：10.1016/j.jhep.2017.05.016.

［32］WEI X Y, LIN B Q, HUANG Y, et al. Effects of time-restricted eating on nonalcoholic fatty liver disease：the TREATY-FLD randomized clinical trial［J］. JAMA Netw Open, 2023, 6（3）：e233513. DOI：10.1001/jamanetworkopen.2023.3513.

［33］ZHANG H J, PAN L L, MA Z M, et al. Long-term effect of exercise on improving fatty liver and cardiovascular

risk factors in obese adults：a 1-year follow-up study［J］. Diabetes Obes Metab, 2017, 19（2）：284-289. DOI：10.1111/dom.12809.

［34］RASTOGI A, RATH I, VARADARAJAN A, et al. Non-alcoholic fatty liver disease （NAFLD） in lean individuals - Single centre large cohort clinicopathologic and immunophenotypic study［J］. Pathol Res Pract, 2022, 238：154112. DOI：10.1016/j.prp.2022.154112.

［35］WIJARNPREECHA K, LI F, LUNDIN S K, et al. Higher mortality among lean patients with non-alcoholic fatty liver disease despite fewer metabolic comorbidities［J］. Aliment Pharmacol Ther, 2023, 57（9）：1014-1027. DOI：10.1111/apt.17424.

［36］YANG C L, ZHAO X Y, HU S Q, et al. Body mass control and non-alcoholic fatty liver disease： evidence from a Chinese population［J］. Medical Journal of Peking Union Medical College Hospital, 2023, 14（1）：44-49. DOI：10.12290/xhyxzz.2022-0691.

［37］Chinese Society of Gerontology and Geriatrics. Guidelines for chronic disease management of non-alcoholic fatty liver disease in the elderly［J］. Chinese Journal of Integrated Traditional and Western Medicine on Liver Diseases, 2022, 32（8）：769-772.

［38］HU Q F, ZHANG Y. A study of the relationship between blood glucose, blood lipids and obesity factors and fatty liver disease［J］. Journal of Modern Medicine & Health, 2016, 32（3）：422-423. DOI：10.3969/j.issn.1009-5519.2016.03.038.

［39］HU C H, Alimizhe A, SU Y X, et al. Analysis of the prevalence and risk factors of fatty liver in adults in the new urban area of Urumqi City in 2020［J］. South China Journal of Preventive Medicine, 2022, 48（6）：703-706.

［40］YANG G L. A study on the correlation between non-alcoholic fatty liver disease and blood glucose, blood lipids, blood pressure and blood uric acid levels［J］. China Medicine and Pharmacy, 2015, 5（17）：191-193.